REMARKS/ARGUMENTS

Claims 1-5 and 8-22 are pending in the present application. By this reply, claims 6 and 7 have been cancelled and new claims 8-22 have been added. Claims 1 and 15 are independent claims.

Drawing Objection

The drawings have been objected to because Figs. 3 and 4 do not depict reference numerals. To overcome this objection, Fig. 3 and 4 have been amended to provide appropriate reference numbers. Figure 2 also has been amended to clarify the invention. These changes to the drawings, as set forth in the attached Replacement Sheets of drawings, do not add any new matter to the disclosure. Accordingly, the objection to the drawing must be withdrawn.

Disclosure Objection

The disclosure has been objected to because of certain informalities. To overcome this objection, the specification has been reviewed and revised to correct the informalities and to clarify the invention. These modifications to the specification do not add any new matter to the disclosure and are fully supported by the original disclosure. Accordingly, the objection to the disclosure must be withdrawn.

Claim Objection

Claim 6 has been objected to because of a certain minor informality. To expedite prosecution only, claim 6 has been cancelled. Thus, this claim objection must be withdrawn.

35 U.S.C. § 112, First and Second Paragraph Rejections

Claims 2 and 4 have been rejection under 35 U.S.C. § 112, first paragraph, as allegedly failing to provide an enablement disclosure. Claims 1-7 have been objected to under 35 U.S.C. § 112, second paragraph, as being indefinite. These rejections, insofar as they pertain to the presently pending claims, are respectfully traversed.

Applicants have reviewed the claims and have revised them to clarify the invention and to improve their form according to U.S. practice. These changes to the claims clarify the invention so as to provide enablement and indefiniteness to the claims as supported by the specification. Accordingly, the rejections should be withdrawn.

35 U.S.C. § 103 Rejection

Claims 1-7 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Knauerhase et al. (U.S. Patent No. 6,215,774) in view of Hadi Salim et al. (U.S. Patent No. 6,535,482). This rejection, insofar as it pertains to the presenting pending claims, is respectfully traversed.

The Examiner equates Knauerhase et al.'s determination of an effective link speed to Applicants' computation of a bandwidth of the network. However, this interpretation is improper because the link speed is not the same as the bandwidth of the network. Thus, Knauerhase et al. does not teach the feature of computing the bandwidth of the network as recited independent claims 1 and 15.

Hadi Salim et al. does not overcome this deficiency of Knauerhase et al. since the Examiner relies on Hadi Salim et al. for teaching a router that determines a degree of congestion.

Furthermore, neither Knauerhase et al. nor Hadi Salim et al. teaches the feature of computing a degree of congestion *of the network*. In Hadi Salim et al., the computed congestion pertains to the router itself and not to the entire network, such that the router itself determines the congestion at the router and discards a received packet based on the degree of congestion at the router. For example, see col. 2, lines 53-54 of Hadi Salim et al.

Therefore, even if the references are combinable, assuming *arguendo*, the combination of references fails to teach or suggest, *inter alia*:

> returning the specific packet received by the destination system to the source system; and
>
> computing a bandwidth and a degree of congestion of the network using the returned specific packet

as recited in independent claim 1; and

> the source device . . . receives the specific packet returned by the destination device, and computes a bandwidth and a degree of congestion of the network using the returned specific packet

as recited in independent claim 15.

Accordingly, the invention as recited in independent claims 1 and 15 and their dependent claims (due to their dependency) is patentable over the applied references, and the rejection must be withdrawn.

CONCLUSION

For the foregoing reasons and in view of the above clarifying amendments, Applicants respectfully request the Examiner to reconsider and withdraw all of the objections and rejections of record, and earnestly solicit an early issuance of a Notice of Allowance.

Should there be any outstanding matters which need to be resolved in the present application, the Examiner is respectfully requested to contact Esther H. Chong (Registration No. 40,953) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and further replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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JTE/EHC:lmh
Attachments:
New Abstract of the Disclosure
Two (2) Replacement Sheets (Fig. 2-4)
Substitute Specification
Marked-Up Substitute Specification

METHOD AND APPARATUS FOR MONITORING NETWORK STATE

BACKGROUND OF THE INVENTION

1. Field of the Invention

[001] The present invention relates to a method and apparatus for monitoring a network state utilized in a network application program connected with the Internet, and more particularly, to a method and apparatus for monitoring a network state which is capable of judging and predicting a network state on the basis of a bandwidth of a network, a packet loss amount and an error occurrence rate, so as to provide an optimum service required by a client.

2. Description of the Background Art

[002] Generally, as a method for monitoring a network state, there are two methods: one method is to use a separate hardware equipment which connects networks, and another method is to judge and predict a network state by installing a network measurement module in an application program of a network PC (Personal Computer).

[003] Additional hardware equipment for measuring a network state includes a Lan card, a Bridge, a Hob and a Router, with which a data provided by a network operating system is analyzed to monitor an Internet network state.

[004] The Router will now be described as an equipment to recognize a network state by using the hardware.

[005] When a client requests information from a server, the router recognizes the number of hops (that is, the number of nodes passed by data to reach a destination network) and the current state of activated paths, based on which a path for transmitting a data is selected. In case that the selected path is busy, other path is selected to transmits the data. At this time, the router is operated including the lower three layers of a physical layer, a link layer and a network layer among the OSI 7 layers, so that the lower three layers can be used to connect different networks.

[006] However, in order to monitor the network state, upper layers higher than a transport layer should operate the same protocol, so that it is difficult to accurately recognize the network state. In addition, ~~a~~ hardware equipment for monitoring the network state is additionally required, so that high expense is incurred.

[007] In the method for installing a network measurement module in an application program of ~~a~~ network PC monitors, a specific module for measuring a degree of congestion of a network in application programs of server and of a client, thereby monitoring a network state.

[008] However, the conventional network monitoring method has a problem in that since the same module should be installed in the application programs of the server and of the client to recognize the degree of congestion of a network, and since the monitoring method is very

complicated, only persons having expertise on the network can use the method.

SUMMARY OF THE INVENTION

[009] Therefore, an object of the present invention is to provide a method and apparatus for monitoring a network state in which a module for monitoring a network state is used to measure a degree of congestion of the network in a network layer, thereby recognizing more practical network state.

[010] To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided a method for monitoring a network state including the steps of: assigning a destination and a monitor period to a module for monitoring a state of a network installed in a source area; generating a specific packet for measuring a bandwidth and a degree of congestion of the network; transmitting the specific packet through a network layer to a designated destination; returning the packet received by the destination to the source area; analyzing a message transmitted from the destination and measuring a bandwidth and a degree of congestion of the network; and repeatedly performing the above steps after the step of generating the packet in every assigned monitor period during a predetermined time to thereby recognize a network state.

[011] To achieve the above objects, there is also provided an apparatus for monitoring a network state which includes a source area

system having a module for transmitting a specific packet through a destination connected to a network and the network to the destination system, analyzing a packet transmitted from the destination, and measuring a bandwidth and a degree of congestion of the network, to thereby recognize a network state.

[012] The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[013] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

[014] In the drawings:

[015] Figure 1 illustrates a network state monitoring system in accordance with the present invention;

[016] Figure 2 is a flow chart of a network state monitoring method in accordance with the present invention;

[017] Figure 3 illustrates a construction of a packet in accordance with the present invention;

[018] Figure 4 illustrates a construction showing an ICMP in an OSI 7 layers of ISO in accordance with the present invention; and

[019] Figure 5 illustrates an Internet service system providing a multimedia application environment in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[020] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[021] A network state monitoring method and apparatus of the present invention will now be described with reference to the accompanying drawings.

[022] Figure 1 illustrates a network state monitoring system in accordance with the present invention.

[023] As shown in ~~the drawing~~ Figure 1, the network state monitoring system includes a source area 100 in which a network state monitoring module is installed, a destination 300 corresponding to an arbitrary system connected with the source area through the Internet, and a network operating system 200 for sensing an error on the network.

[024] First, when the source area 100 transmits a specific packet through a network layer to a designated destination 300, the destination 300 returns the received packet to the source area.

At this time, in case that an error occurs during the transmission of the packet, the network operating system 200 transmits an error message to the source area 100. Then the source area 100 analyzes the message transmitted from the destination or from the operating system and measures the bandwidth and the degree of congestion of the network to recognize a network state, so that a data suitable to the bandwidth of the network can be transmitted.

[025] The operation and effect of the present invention will now be described with reference to Figures 2, 3 and 4.

[026] Figure 2 is a flow chart of a network state monitoring method in accordance with the present invention.

[027] First, a destination and a monitor period are assigned in the network state monitoring module installed in the source area (S1). A packet is assigned by the source area in a data field of an ICMP (Internet Control Mangement Protocol) to obtain a bandwidth and a degree of congestion of the network between the source area and the destination (end-to-end) (S2), thereby generating an S-bit IP (Internet) datagram, that is, a packet.

[028] The source area system transmits the generated IP datagram to the destination system through ~~the~~ its ICMP (S3), of which the transmission time is set by 'T1'.

[029] The packet transmitted through the ICMP is returned from the destination system to the source area system (S7).

[030] At this time, in case that ~~an error~~ some error (e.g., a data transmission error) occurs on the network, the network operating system

detects the occurrence of the error and transmits an error message to the source area.

[031] The source area system receives the packet from the destination system or from the network operating system and analyzes the received message (S4), of which the message receiving time is set by 'T2'.

[032] The source area system analyzes the received message, and in case that ~~there is an error,~~ the source area system ~~receives~~ detects an error on the network (S5), the source area system transmits an error cause data ~~from~~ to the destination system (S8). Meanwhile, in case that there is no error on the network (S5), the source area system computes a degree of congestion and a bandwidth of the network. The bandwidth of the network is computed by dividing the length of the packet by a difference between the receiving time and the transmission time, and the degree of congestion of the network is measured ~~in a manner that~~ based on the loss and the order of the packet from the permutation number in the packet of the IP datagram, ~~and the degree of congestion is measured~~ i.e., on the basis of the computed bandwidth~~,~~ and the packet loss amount, or whether ~~an~~ a packet transmission error has occurred.

[033] Formula representing the bandwidth of the network is as follows.

A network bandwidth (bps)=S/(T2-T1) ---------- (1)

wherein S indicates the length of the packet, T1 indicates a time at which the source area transmits the IP datagram to the destination, and T2

indicates a time at which the packet transmitted from the destination is received.

[034] In case that the source area and the destination are the same, in order to obtain a bandwidth and a degree of congestion of a network between the source area and the destination (end-to-end), it returns to the step S2 in which a packet is assigned in the data field of the ICMP (Internet Control Management Protocol), and the steps S3, S4, S5, S6, S7 and S8 are performed for a predetermined time in every assigned monitor period, to obtain an average value and the maximum and the minimum values, thereby recognizing the degree of congestion of the network as well as the network state.

[035] Meanwhile, in case that the source area changes the destination, the steps after the step (S1) of assigning the destination and the monitor period are again performed.

[036] Figure 3 illustrates a construction of a packet in accordance with the present invention.

[037] As shown in ~~the drawing~~ Figure 3, the IP datagram transmitted through the ICMP includes an IP header 20, an ICMP header 21, a packet number 22 and an arbitrary character string 23. Assuming that the length of the packet is 'S', 124 byte data at the maximum can be stored in the packet so as to be transmitted.

[038] Figure 4 illustrates a construction showing an ICMP in an OSI 7 layers of ISO in accordance with the present invention.

[039] With reference to Figure 4, the ICMP 30 positioned at the network layer 31 of the OSI (Open System Interconnect Mode) 7 layers is utilized in which a bandwidth value close to a bandwidth value obtained in the TCP 32 and the UDP 33 of the transport layer 34 can be obtained, which is not affected by the TCP 32 and the UDP 33 of the transport layer 34 positioned at the upper portion of the network layer 31. Also, the bandwidth value is not affected by layers positioned above the transport layer 34.

[040] As described above, in the network monitoring method, since the bandwidth value obtained in the ICMP is affected only by the lower portions of the network layer, without being affected by the layers above the transport layer, the network state can be recognized close to the network situation, the network connection state of an arbitrary destination system can be recognized, and the degree of congestion of the TCP/IP layer of the Internet protocol, that is, the degree of congestion of network itself, can be measured.

[041] In addition, even though the module for monitoring the network state is installed only at one side of either the source area or the destination, the network state can be monitored. In case where a module for monitoring a network state is installed at one side, there is a load only in a system where the monitoring module is positioned while there is no load in a system without having the module or there is little load negligible in a system without having the module. Thus, the load of the whole system and network can be minimized.

[042] Moreover, in the method for monitoring the network state, once the TCP/IP is mounted at a system connected with the Internet, a network state can be monitored, so that the bandwidth and a degree of congestion of the network can be recognized.

[043] The method for monitoring a network state of the present invention is applicable to every application program for measuring a degree of congestion of a general network, ~~that is~~ e.g., a network of the Internet or an ~~Intranet~~ intranet.

[044] Figure 5 illustrates an Internet service system providing a multimedia application environment in accordance with the present invention.

[045] As shown in ~~the drawing~~ Figure 5, the Internet service system includes a plurality of servers 400 for providing multimedia contents, a plurality of clients 600 for displaying data transmitted from the servers 400 for users, and a Web-based service gateway 500 for providing Internet information and additional information to the ~~user~~ users.

[046] In the Internet service system, an arbitrary client 600 selects a service content according to the method for monitoring a network state as described above among the servers 400 providing a requested service. In case of a system having several servers 400, the service gateway 500 can balance a load for the service requested by the client 600 by using the method for monitoring a network state.

[047] Meanwhile, a server 400 including a plurality of contents of the same content having various kinds of encoding rates selects ~~a~~ specific

contents executable in the current network situation for the service requested by the client 600 to provide a service.

[048] As so far described, the method and apparatus for monitoring a network state of the present invention ~~has~~ have the following effects.

~~That is, first~~**[049]** First, the degree of congestion and the bandwidth of a network ~~is~~ are measured in the network layer, so that an actual network state can be recognized.

[050] Secondly, even though a module for monitoring a network is installed only at one side of either a source area or a destination, a network state can be monitored, so that the load of the whole system and the network can be minimized.

[051] Thirdly, it is not necessary to employ ~~a~~ hardware to monitor a network state as in the conventional art, so that the network state can be monitored at a low expense.

[052] Lastly, since the ordinary users without expertise on the network can recognize the network state, its utilization can be heightened.

[053] As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the meets and bounds of the claims, or

equivalence of such meets and bounds are therefore intended to be embraced by the appended claims.